RIDOT'S Statewide Roadway and Asset Data Collection Project

ESRI User Conference 2017

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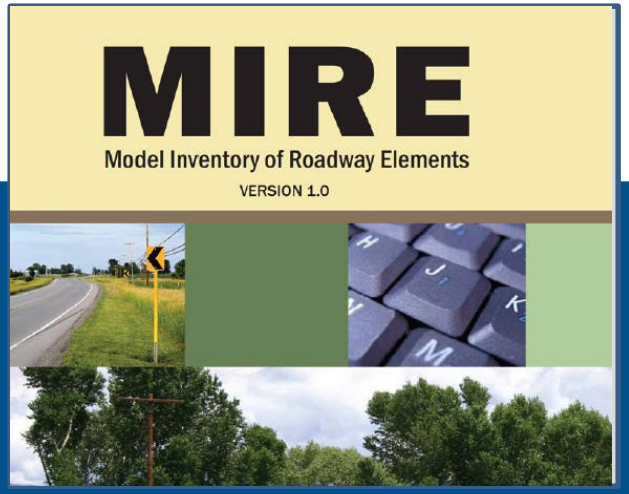

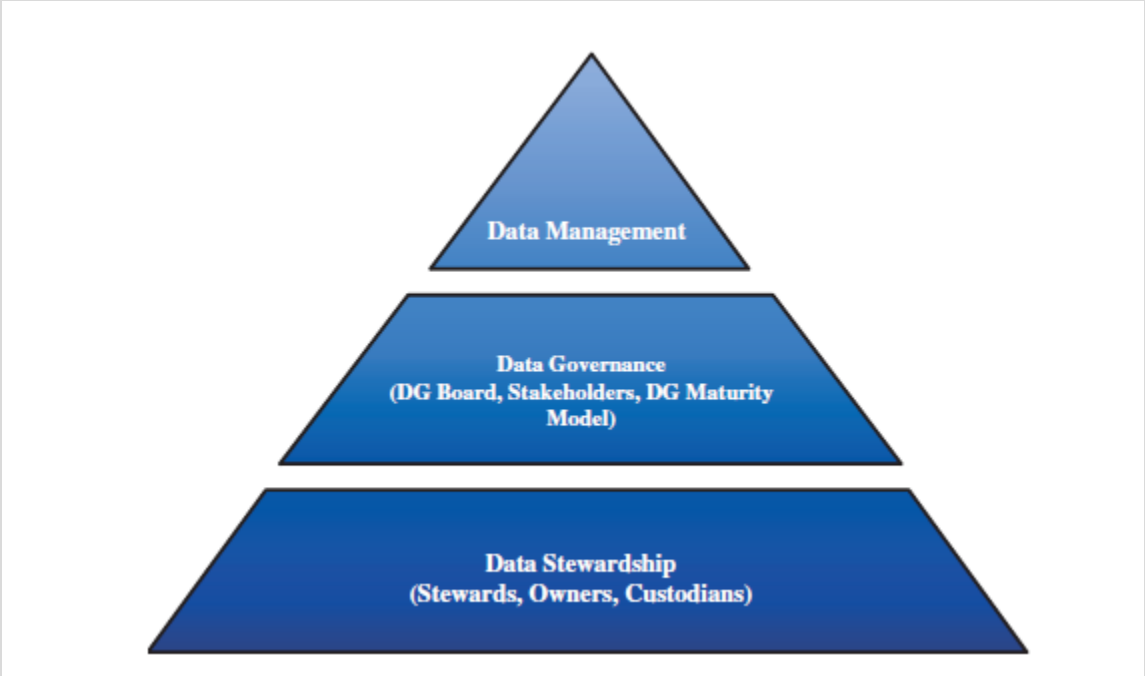

What is MIRE?

Recommended Listing of Roadway and Traffic Inventory Elements

- Guideline for Agencies
- Critical to Safety Management
- Helps Move Agencies Towards Use of Performance Measures

Benefits Beyond Safety

- Decision Makers
- Asset Management
- Infrastructure
- Operations
- Maintenance

Driven to get you there

Why Do We Need This Data?

- Identify risk factors
  - From crash data
  - From roadway data
  - From other studies

Intersection Features:

- Intersection skew angle
- Intersection traffic control device
- Number of signal heads vs. number of lanes
- Presence of backplates
- Presence of advanced warning signs
- Intersection located in/near horizontal curve
- Presence of left-turn or right-turn lanes
- Left-turn phasing
- Allowance of right-turn-on-red

Roadway Features:

- Number of lanes
- Lane width
- Shoulder surface width/type
- Median width/type
- Horizontal curvature
- Roadside or edge hazard rating
- Driveway density
- Presence of shoulder or centerline rumble strips
- Presence of lighting
- Presence of on-street parking

Pedestrian Features:

- Crosswalk presence
- Crossing distance
- Signal head type
- Adjacent land uses
- Lighting

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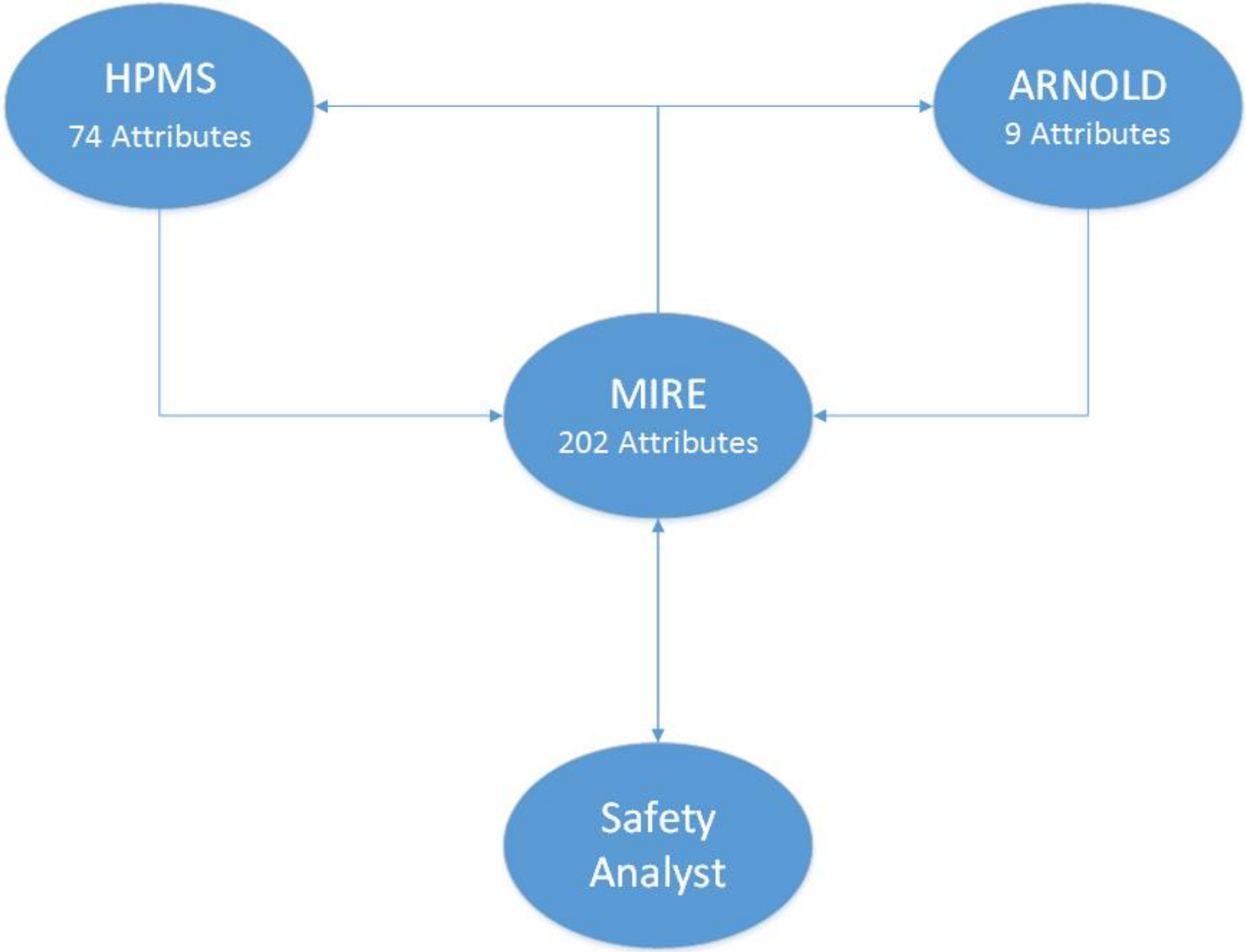
MIRE Across Datasets



Type of Data in MIRE

- Segment Location / Linkage Elements
  - Street Name, Route Number, Town Code, Etc.
- Segment Classification
  - Functional Class, Rural / Urban, Etc.
- Segment Cross Section
  - Surface Descriptors
    - Surface Type, Pavement Condition, Etc.
  - Lane Descriptors
    - Number of Lanes, Cross Slope. Etc.
  - Shoulder
    - Shoulder Type, Sidewalk Presence, Etc.
  - Median
    - Median Type, Side Slope, Etc.
  - Roadside
    - Clear Zone, Driveway Count, Etc.

Type of Data in MIRE

- Segment Traffic Operations / Control Data
  - One/Two Way, Speed Limit, Roadway Lighting, Etc.
- Horizontal Curve Data
  - Curve Degrees, Curve Length
- Vertical Grade
- Roadway Junction Descriptors (Intersections)
  - General Descriptors
    - Type of Intersection, Number of Legs, Signal Presence, Etc
  - Each Approach
    - Through Lanes, Median Type, Crosswalk Presence, Etc.
- Interchange and Ramps Descriptors
  - Interchange Type, Number of Lanes, Speed

MIRE Data Collection Effort

Timeline

- Scope of Work June 2013
- RFP Completed May 2014
- NTP September 2014
- Data Collection Completed December 2015
- Beginning to use the data to perform predictive safety analysis, particularly on corridors

Scope of Work

- Collect 180 of 202 MIRE Elements
- Traffic Volume Related Elements Not Collected (79-90, 140-141, 160, 163-166, 184, 191-192)
- Also Responsible for Collecting ROW Imagery, Pavement Roughness & Distress Data, LIDAR, and Additional Asset Data

Asset Data Collected

- Pavement
  - Roughness, Rutting, Patching, Bleeding
  - Collected on State, NHS, Numbered Routes, Ramp, Municipal Federal Aid
- Mobile LiDAR for 1300 Miles of State Road and Some Ramps
- ROW Imagery for State Roads
- Asset Features
  - Statewide
    - Road Inventory
    - Signs
  - State Roads
    - Guardrail
    - Walls
    - Catch Basins and Manholes
    - Striping
    - Bridge Vertical Clearance

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Data Integration and Governance

Data Integration Through ESRI Roads & Highway Implementation

- Conversion From Multiple LRSs Supporting Various Business Systems to a Unified LRS Platform (While Supporting Multiple LRMS)
- Supporting Bi-Directional Data Flow and Consistent Location Referencing Across Business Systems

Rhode Island Local/State Data Integration For Asset Management and Safety Analysis – In Progress

- Develop processes and identify staffing and resources needed to guarantee the ongoing maintenance and utility of the roadway location and MIRE inventory data
- Manage data integration and assist the RIDOT in developing processes for integration of the new MIRE data into ESRI Roads and Highways
- Support use of advanced analytic tools/methodologies through example analyses and training on data extraction/integration processes

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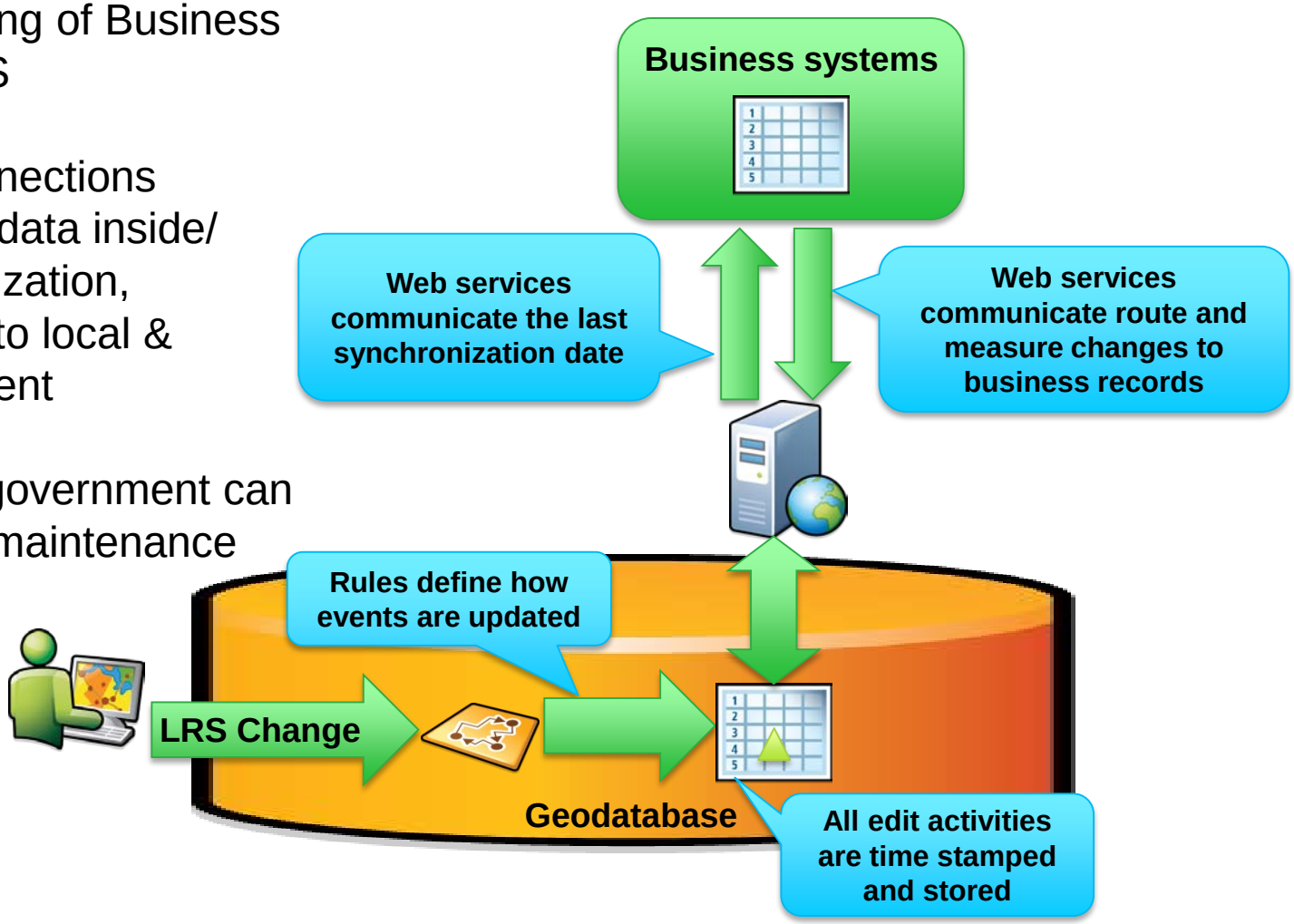
Automated Sync'ing of Business Systems with LRS

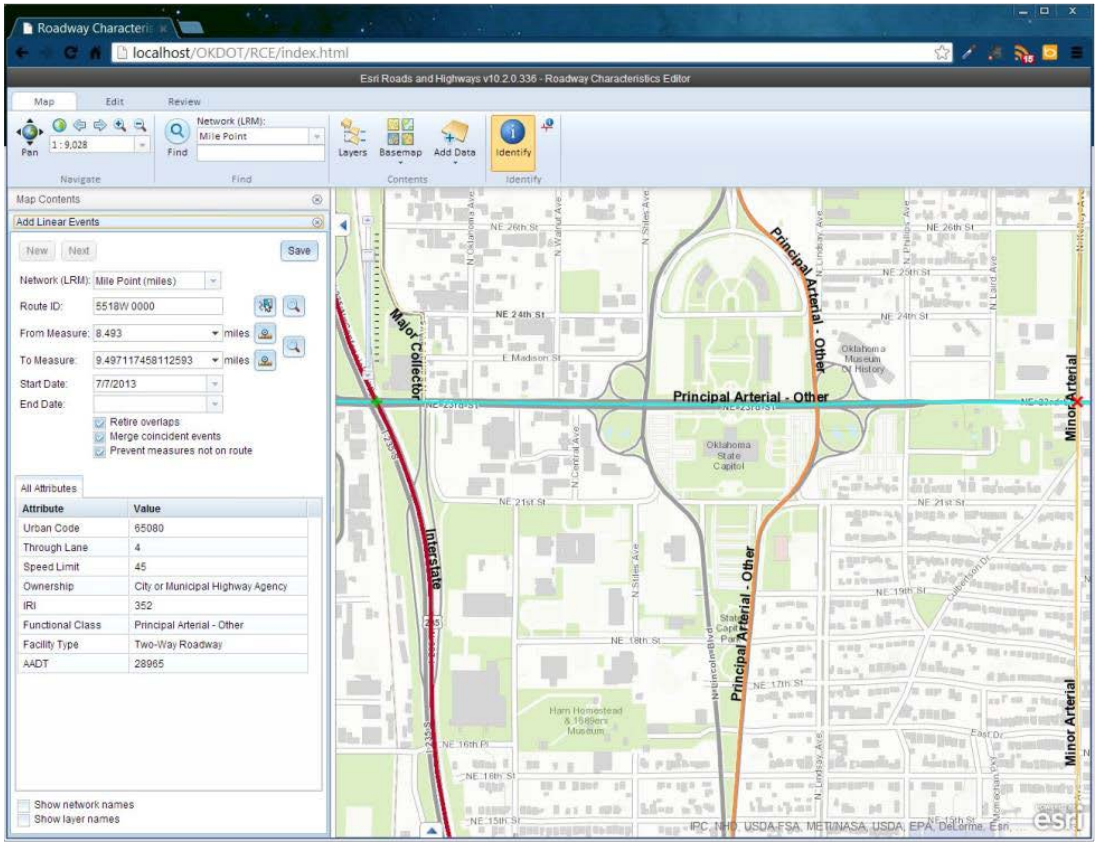
Web Service Connections extend access to data inside/ outside the organization, providing access to local & regional government

Local & regional government can participate in the maintenance of the database



Roads & Highways Road Characteristic Editor (RCE) provides a web portal that can be configured to provide access to local/regional government

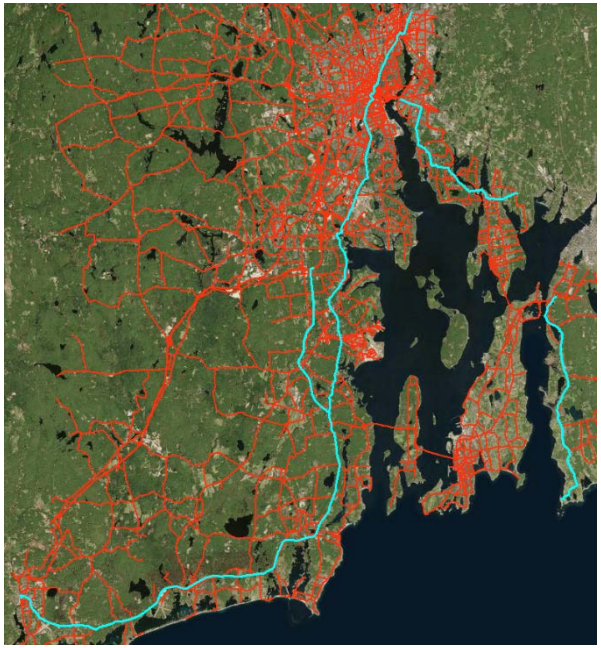
Local & regional government can actively participate in the maintenance of the road network



- MIRE has no standardized data model, only guidance
- Wanted something basic that could be improved upon
- Needed something that could easily be edited and moved to various formats

Intersection_Approach_Table	File Geodatabase Table
Intersection_Approaches	File Geodatabase Relationship Class
MIRE_Intersections	File Geodatabase Feature Class
MIRE_Mainline	File Geodatabase Feature Class
MIRE_Ramps	File Geodatabase Feature Class

Data Collection

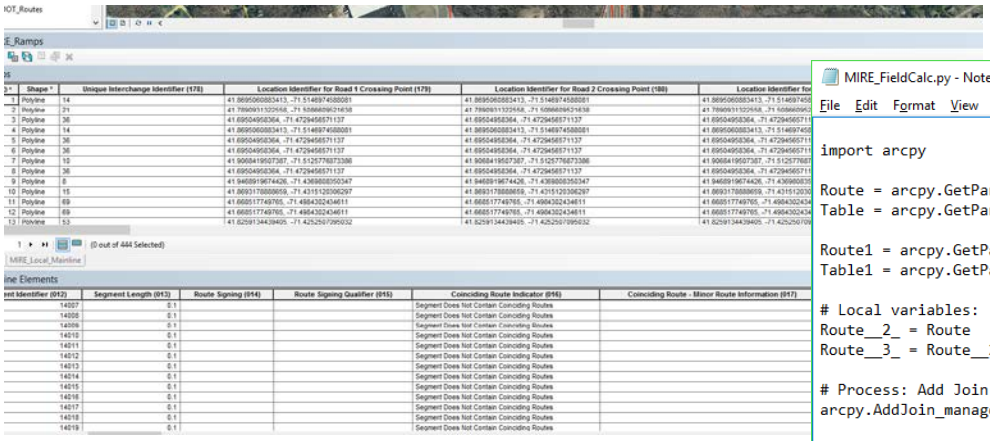


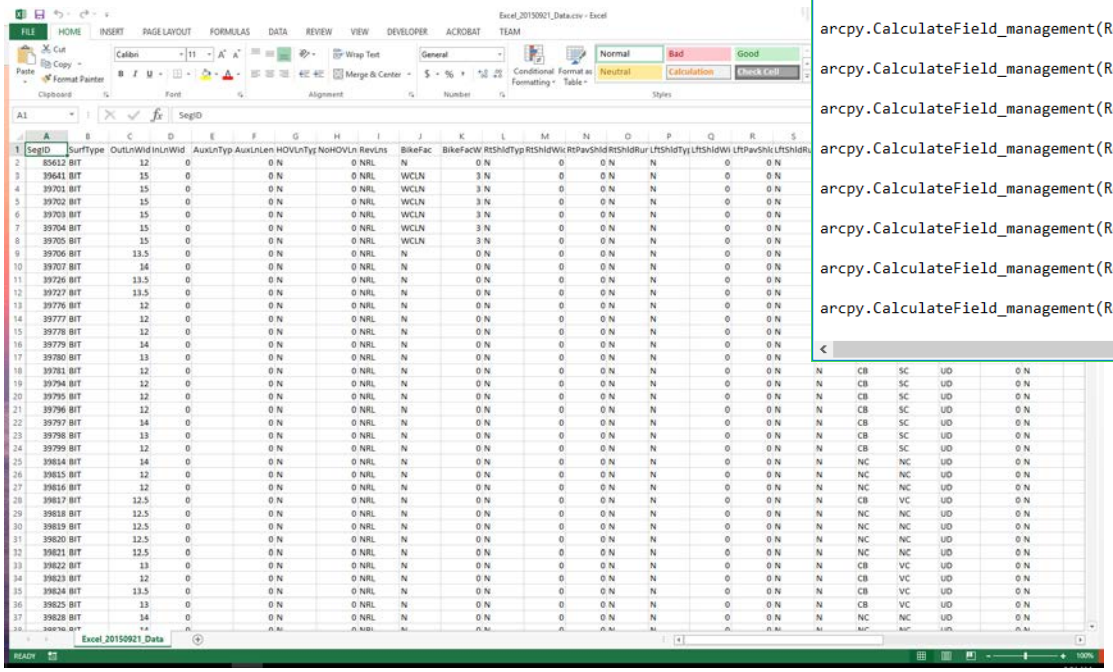
- MAC vehicles collect data along predefined routes
- Directionality important consideration
- Mutliple datasets with differing priority levels
- GPS tracks used to track collection

Driven to get you there

- Data from various sources
  - Aerial imagery
  - ROW imagery (collected by MAC vehicles)
  - LiDAR
  - Existing RIDOT data

Data Population





MIRE_FieldCalc.py - Notepad

File Edit Format View Help

```
import arcpy

Route = arcpy.GetParameter(0)
Table = arcpy.GetParameter(1)

Route1 = arcpy.GetParameterAsText(0)
Table1 = arcpy.GetParameterAsText(1)

# Local variables:
Route__2_ = Route
Route__3_ = Route__2_

# Process: Add Join
arcpy.AddJoin_management(Route, "SegID", Table, "SegID", "KEEP_ALL")

# Process: Calculate Fields
arcpy.CalculateField_management(Route__2_, Route1 + ".SurfType", "!" + Table1 + ".SurfType!", "PYTHON")

arcpy.CalculateField_management(Route__2_, Route1 + ".OutLnWid", "!" + Table1 + ".OutLnWid!", "PYTHON")

arcpy.CalculateField_management(Route__2_, Route1 + ".InLnWid", "!" + Table1 + ".InLnWid!", "PYTHON")

arcpy.CalculateField_management(Route__2_, Route1 + ".AuxLnType", "!" + Table1 + ".AuxLnType!", "PYTHON")

arcpy.CalculateField_management(Route__2_, Route1 + ".AuxLnLen", "!" + Table1 + ".AuxLnLen!", "PYTHON")

arcpy.CalculateField_management(Route__2_, Route1 + ".HOVLnType", "!" + Table1 + ".HOVLnType!", "PYTHON")

arcpy.CalculateField_management(Route__2_, Route1 + ".NoHOVLns", "!" + Table1 + ".NoHOVLns!", "PYTHON")

arcpy.CalculateField_management(Route__2_, Route1 + ".RevLns", "!" + Table1 + ".RevLns!", "PYTHON")

arcpy.CalculateField_management(Route__2_, Route1 + ".BikeFac", "!" + Table1 + ".BikeFac!", "PYTHON")

arcpy.CalculateField_management(Route__2_, Route1 + ".BikeFacWid", "!" + Table1 + ".BikeFacWid!", "PYTHON")
```

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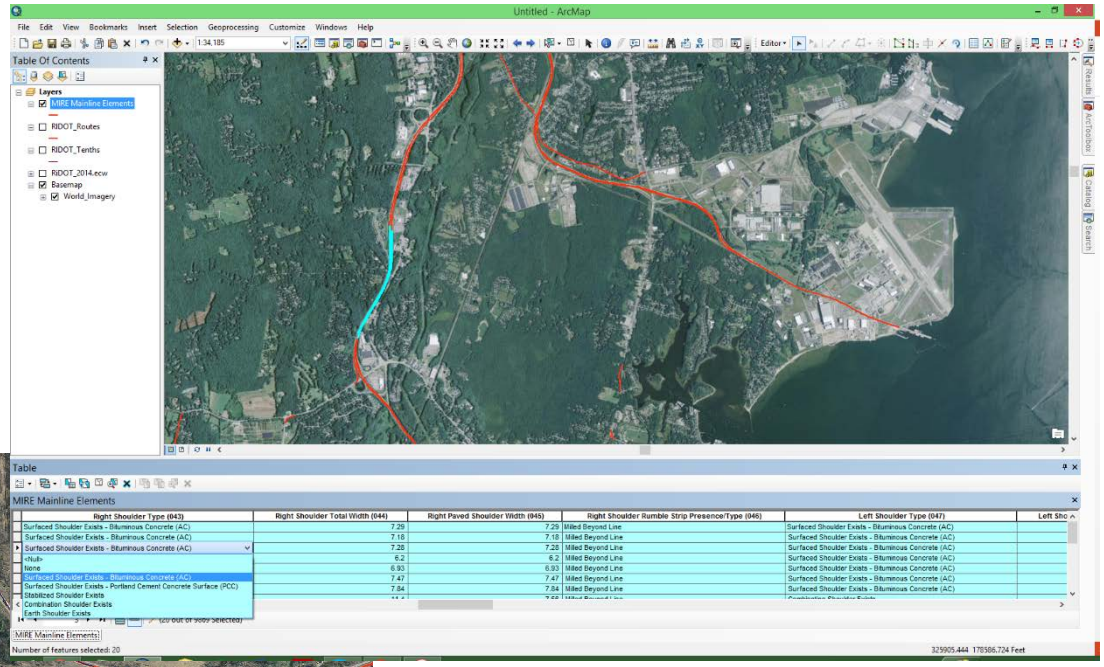
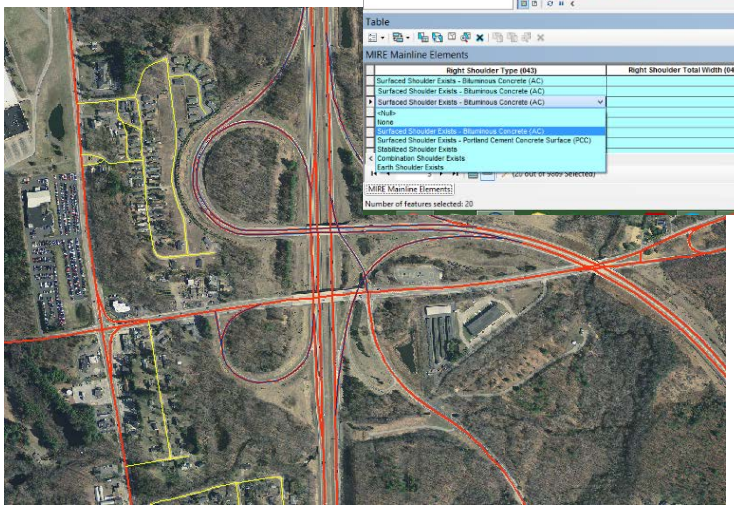
Data Population

- Data populated at 1/10th of a mile segments
- Coded domain values used
- Populated specifically based on type of roadway elements





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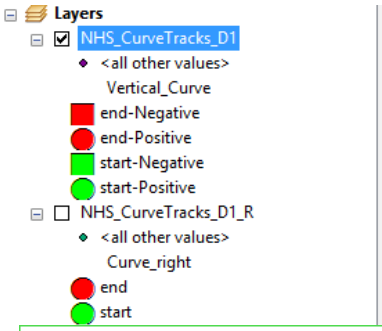
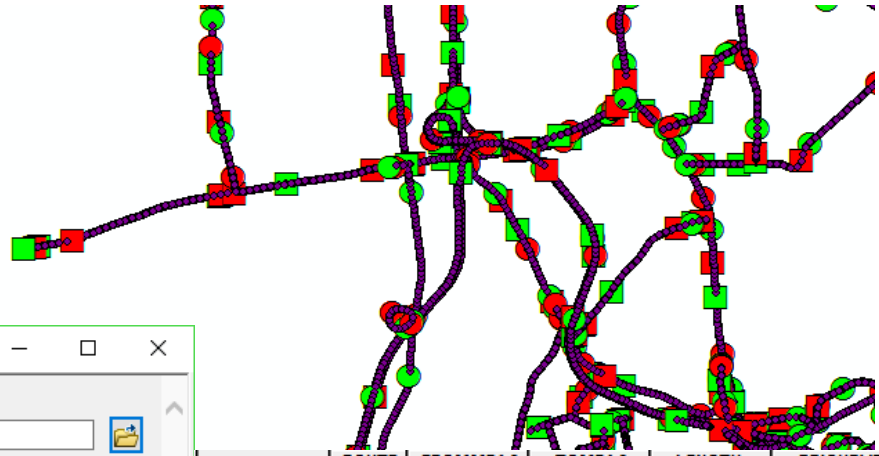
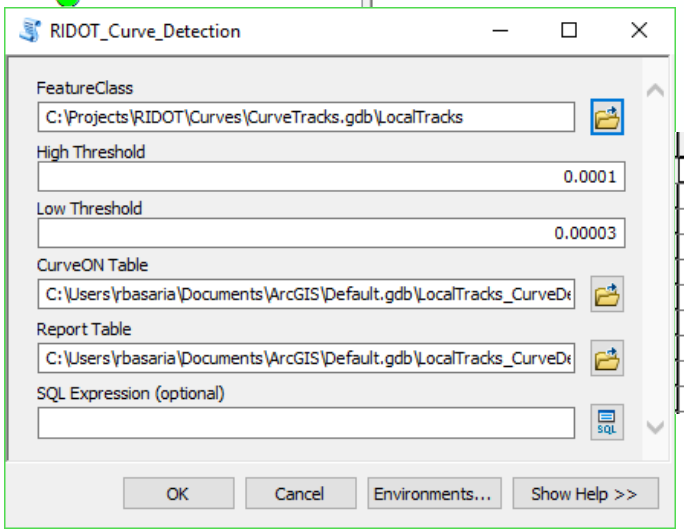
Curves

- Biggest hurdle with data
  - New process that seemed to have never been done before.
- Developed Python scripts to detect curves
  - Scripts use point data created from LRS to determine curve start/end measures, length, and radius of curve







OBJECTID *	ROUTE	FROMMEAS	TOMEAS	LENGTH_	PRICURVE	CURVEDEGRAD
1	3480	1921.104292	2004.766078	83.661786	88.189292	122.900705
2	3480	1298.946885	1719.278893	420.332008	-416.03681	775.885922
3	3480	91.647063	374.509841	282.862778	293.180606	238.625218
4	3480	34.809941	77.112581	42.302639	-42.831897	307.356037
5	9742	6559.054265	6601.785167	42.730902	42.943952	1117.683622
6	9742	5977.918336	6530.362808	552.444471	-544.097955	678.538929
7	9742	4967.935026	5906.465683	938.530657	953.923761	507.247404
8	9742	3620.518931	4752.094593	1131.575662	-1116.629282	758.804267
9	9742	3123.859872	3504.92959	381.069718	377.583237	-1.869702e+028
10	9742	756.208717	1136.826078	380.617361	-369.966627	226.727776

RI dot
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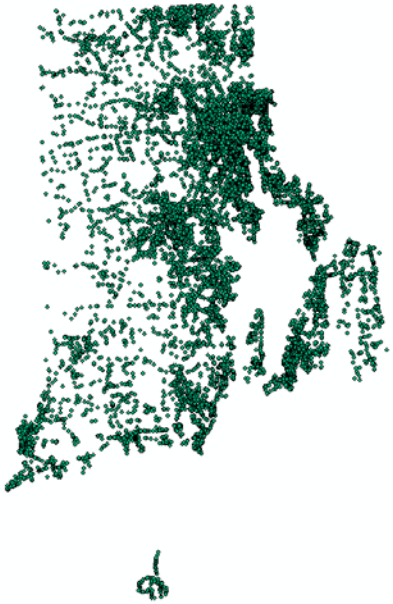
QC Before Delivery to RIDOT

- Initial QC performed by Michael Baker
- Manual and Automated QC performed
- Mainline
  - 86,522 segments, 6,932 miles, 120 MIRE Elements
- Intersections
  - 16,215 intersections, 49,337 intersections approaches, 57 Elements
- Ramps
  - 444 ramps, 25 Elements



QC Before Delivery to RIDOT

- Manual processes used to QC data using symbology
  - Find areas where symbology differs, and could potentially be errors
  - Applied to attributes such as speed limit, sidewalk presence, median information, etc.
  - Reports delivered in the form of word documents describing issue with screen captures for specific Segment IDs
- Automated processes
  - Scripts built for cross attribute validation and domain validation
  - Applied to all datasets
  - Validation rules developed based on MIRE guidelines
  - 80 cross attribute validations
  - 90 domain validations
  - Reports delivered to DTS in the form of CSV files with issues listed by Segment ID

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Lessons Learned/Challenges

- No standard data model for MIRE
  - Had to develop data model
  - Numerous iterations to work out best geometric and attribute representations
  - Built GDB with domains for all MIRE Elements that could be coded
- DOTs vs Consulting
  - Managing expectations
  - Keeping all participants up-to-date on project status
  - LRS updates during project

Lessons Learned/Challenges (Cont'd)

- FHWA should develop a geospatial data model for use by any agency interested in implementing MIRE. The data model should template GIS feature classes, attribute domains within each feature class, and necessary relationship classes between features.
  - A substantial amount of time was spent by the MIRE Contractor developing a GIS data model to house the MIRE data collection.

- MIRE Contractor identified the need for additional details for each MIRE element to be located in a single reference document.
  - Although safety engineers are the primarily consumers of the MIRE data, data collection Contractors are more likely to be experts in GIS or mobile data collection technology, without in-depth knowledge of each MIRE element.

Lessons Learned/Challenges (Cont'd)

- MIRE junction elements are split between two types of geometry: A point feature with attributes describing the intersection; 3 or more linear features representing the intersection approaches.
  - Each intersection represented as a point with attributes describing the intersection.
  - Intersection approach elements stored in a Related Table and linked to the intersection point based on the intersection identifier.
- MIRE does not require the intersection approach to be linked to the road segment ID, only the intersection ID.
  - Poses a problem when implementing Safety Analyst and linking crash data to segments and approaches.

Moving Forward

- MIRE Road Inventory to be Imported into Esri Roads & Highways and Managed as part of RIDOT's LRS
  - MIRE elements will be dissolved from 1/10 mile centerline segments into LRS routes with event tables
- Develop Geoprocessing Tools to Extract Data from Esri Roads & Highways for import into Safety Analyst
  - Safety Analyst will not work with the Esri Roads & Highways event tables
  - Additional data fields (processed from existing attributes) required for import to Safety Analyst
- MIRE Element Attribute Definitions differ from Safety Analyst Requirements
  - Two Options:
    - Manually attribute map the MIRE attribute definitions within Safety Analyst as part of the data import process
    - Translate MIRE attributes to Safety Analyst definitions through scripting outside of Safety Analyst

Comments & Questions

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